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Notes on the Flora of High Altitudes in Custer County, Colorado.

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During the last few years, while residing in Wet Mountain Valley, I have endeavored, as opportunity permitted, to ascertain something of the flora and fauna of the high altitudes in the Sangre de Cristo Range. The present notes are the results of these investigations, so far as regards the flora of this region. The species enumerated were collected on the eastern slope, in Custer County, and so far as I could guess at the altitudes, (having no aneroid), all are from 10,000 feet above sea level or upwards. These records, which all relate to the plants of the vicinity of Gibb's Peak, (miscalled Gibson Peak on the maps), will give a very fair idea of the general features of the flora, but it is to be remembered that the cryptogamia, grasses, carices, etc., were almost entirely neglected. There is a great opportunity for some future student of these groups in this district.

Most of the species from the Lakes of the Clouds, (11,000 feet or over), were collected by Mrs. M. E. Cusack, and many of the new forms enumerated are in her herbarium. I am greatly indebted to Dr. George Vasey, Dr. J. M. Coulter, Mr. F. W. Anderson, and Mr. J. B. Ellis, for the identification of some of the species.

RANUNCULACEÆ. About the Lakes of the Clouds are found *Ranunculus abortivus* and *R. pygmæus*, and *Trollius laxus*. In the timber one meets with an abundance of *Aquilegia cærulea*, a plant of great beauty and interest. Near the lakes, (whenever in this paper I refer to "the lakes," the Lakes of the Clouds are intended), occurs a f. *pallidiflora*, collected by Mrs. Cusack, with the flowers smaller, white tinged with blue, pods five, and larger leaves. In cultivation, a somewhat similiar variety has been produced, for Vilmorin's catalogue for 1889, p.114, enumerates a form, "à fleur blanche." It is noticeable that blue flowers most often vary to white.* Near the Micawber Mine there occurs a second variety of *A. cœrulea*, which I will call f. *glandulosa*.† It has six pods, and the peduncles and pods are pubescent and viscid-glandular. One head was found with as many as seven pods, but six is the usual number. The remaining Ranunculaceæ occur near the Micawber mine; *Actœa spicata* var. *arguta*, with red berries; and *Delphinium occidentale*, which has also a f. *subroseum*, with the sepals dull bluish-pink, and the plant not so tall.‡

BERBERIDACEÆ. *Berberis repens*, in the Micawber Mine Gulch, is the only representative of the order.

CRUCIFERÆ. *Cardamine cordifolia*, near the Micawber and in Swift Creek Gulch, and *Erysimum asperum*, in the Micawber Mine Gulch, are conspicuous. *E. asperum* presents two forms: of which f. *alpestre*, growing at about 10,000 feet, has the flowers becoming deep orange-brown.|| At timber line I found the other form —only 61 millimeters high, although the flowers are yellow and of the usual size. Near the Micawber Mine there occurs a puzzling *Sisymbrium*, which I will provisionally call *S. canescens* var. *alpestre*. It is tall, glabrous, stem with a white "bloom;" pods ascending, mostly longer than pedicels. *E. asperum* f. *alpestre*

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* I have found this so in my experience, and Mr. F. W. Anderson, who is a close observer, writes me, (December 4th, 1889), as follows: "Yes, undoubtedly blue flowers more often vary to white than do those of any other color. Examples, various common Astragali, Lupins, Delphiniums: Gentians, like the yellows, are more apt to vary to green or greenish."

† There is already a species *A. glandulosa*, in Siberia, but this need not interfere with the use of that name for our present *form*.

‡ *D. scopulorum*, which occurs abundantly at a lower altitude, I did not observe varying in this manner.

|| This variation occurs as the effect of altitude: lower down, the flowers of this species are yellow. A more extreme form, which I have not seen, has the flowers purple; Miss A. Eastwood found it in the Uncompaghre Cañon. Thus we arrive at the normal colors of some other Cruciferæ.

was found in flower at 10,000 feet, as late as Oct. 9th. *Achillea millefolium*, on Oct. 10th, was the last flower of the year at that high altitude.

CAPPARIDACEÆ. This order has only a place in this list because seeds brought in hay to the Micawber Mine gave rise to a plant or two of *Cleome integrifolia*, a species normally occurring from 8,000 feet downwards.

VIOLACEÆ. *Viola Canadensis*, in the Micawber Mine Gulch.

CARYOPHYLLACEÆ. *Arenaria saxosa* near the lakes; and *Silene acaulis*, at timber line, above Brush Creek, the latter a form with pink flowers on peduncles about 15 millimeters long. *Saponaria Vaccaria*, growing near the Micawber, is merely the result of seeds from hay.

MALVACEÆ. *Sidalcea candida*, near the Micawber.

SAPINDACEÆ. *Acer glabrum*, common near the Micawber.

LEGUMINOSÆ. *Trifolium Parryi* and *T. dasyphyllum*, near the lakes—the latter also near Brush Creek. In the neighborhood of the Micawber we find *Thermopsis montana* and *Astragalus alpinus*, (a form with stipe shorter than calyx); and in Horseshoe Bend Gulch, at barely 10,000 feet, *Lupinus argenteus* occurs on a sunny slope.

ROSACEÆ. Near the lakes, *Potentilla dissecta*, *P. fruticosa*, *Rubus strigosus*, and *Fragaria vesca*—and the last three also near Brush Creek. Above the Micawber Mine occurs a f. *humilis* of *P. fruticosa*, a lower form with about twenty-five stamens: the more ordinary form has about thirty stamens; so this species varies in this matter like the *arguta* section. In the Micawber Mine Gulch are also found *Potentilla gracilis*, *Rosa blanda*, and *Geum macrophyllum*.

SAXIFRAGACEÆ. *Saxifraga nivalis*, *S. bronchialis*, *S. punctata*, and *Ribes lacustre* near the lakes, and the last three also near Brush Creek. *Parnassia fimbriata* occurs near the Micawber.

CRASSULACEÆ. *Sedum rhodanthum*, near the lakes; and above the Micawber *S. stenopetalum*, with a f. *rubrolineatum*, in which the angles of the closed buds are red; when the flower is open the peculiarity is less conspicuous. This is a very interesting variety, showing the tendency to vary to red—red being a normal color in others of the genus.

ONAGRACEÆ. *Epilobium spicatum* is of course abundant. At the Micawber is found *E. coloratum* f. *albiflorum*, with white flowers and glabrous pods. The *Œnotheras*, so conspicuous lower down, are completely absent.

UMBELLIFERÆ. Near the Micawber are *Heracleum lanatum*, *Ligusticum montanum* and *Osmorhiza nuda*. On bare ground at timber line I found a *Peucedanum*, apparently *bicolor*. I submitted it to Dr. Coulter, who remarked that so far as vegetative characters went it agreed with *bicolor*, but since it was gathered too early for fruit, its identity could not be made certain.

CAPRIFOLIACEÆ. *Lonicera involucrata*, *Symphoricarpos oreophilus*, and *Sambucus racemosa*, near the Micawber, and the last also in Swift Creek Gulch. The variation in the color of the fruit of *S. racemosa*, near the Micawber, is very striking. The ordinary form has bright scarlet fruit, but there are two varieties; f. *xanthocarpa*, with cyme rather broader, peduncles deep dark crimson, fruit pale yellow, leaves larger ; and f. *oinocarpa*, with fruit dull crimson. These varieties all grow together, and appear to differ in only the characters given here. According to Wood, *Sambucus* "*pubens*" has "berries rarely white." Although these elder-berries are so conspicuous, they do not seem to be eaten, not at any rate very largely, by birds.

RUBIACEÆ. *Galium boreale* is abundant near the Micawber Mine.

COMPOSITÆ. *Senecio aureus* var. *croceus*, *S. Fendleri*, *S. wernericæfolius*, *Aster foliaceus* var. *Parryi*, *Cnicus eriocephalus*, *Troximon glaucum*, *Aster Fremonti*, and *Achillea millefolium* occur near the lakes, and the last two near the Micawber Mine. *Cnicus eriocephalus*, a form with bright, chrome yellow corollas, is very conspicuous above the timber line, near Brush Creek. *Aster Fermonti*, near the Micawber, has two forms, *a. pallidus*, rays white, or nearly so, *b. vividus*, rays shorter, more numerous, lilac, with the outer involucral bracts dark, and shorter, radical leaves about 109 millemeters long. *Gymnolomia multiflora* occurs in Horseshoe Bend Gulch, and near the Micawber, and the following occur at various altitudes up to timber line in the Micawber Mine Gulch: *Artemisia scopulorum*, *A. franserioides*, *Antennaria dioica*, var. *rosea*, D. C. Eaton, (remarkable nodding forms at timber line), *Troximon aurantiacum*, *T. glaucum*, f. *alpestre*, (beak of akenes about 6 millemeters long, hardly as long as the pappus, the bracts with dark blotches outside, the leaves narrow, and entire). *Cnicus Parryi*, *Aplopappus Parryi*, *Erigeron glabellus*, var. *mollis*, and *Arnica cordifolia*. *Helianthus petiolaris*, near the Micawber, sprung from a dropped seed, and looked strangely out of place.

CAMPANULACEÆ. *Campanula rotundifolia*, Horseshoe Bend Gulch and Micawber Mine Gulch.

ERICACEÆ. *Moneses uniflora* and *Pyrola secunda*, near the lakes; and *Arctostaphylos Uva-ursi*, *Vaccinium myrtillus* and *Pyrola rotundifolia* var. *uliginosa*, near the Micawber. The *Vaccinium* replaces *Arctostaphylos* as we ascend.

PRIMULACEÆ. *Dodecatheon media* in the Micawber Mine Gulch, and var. *alpinum*, near the lakes. *Primula Parryi* is conspicuous in Swift Creek Gulch, and Horseshoe Bend Gulch.*

APOCYNACEÆ. *Apocynum androsæmifolium* near the Micawber.

GENTIANCEÆ. *Frasera speciosa* is abundant at timber line, near Brush Creek, and lower down one meets with *Gentiana heterosepala*, and near the Micawber *G. barbellata*, the latter being also found near the lakes. I found *Swertia perennis* in flower at the lakes in September, and Mrs. E. B. Cox showed me a specimen of *Gentiana frigida* also collected there.

POLEMONIACEÆ. *Polemonium humile* var. *pulchellum* and *P. confertum*,† near the lakes, the latter at timber line, above Brush Creek, where also occurs *Phlox cæspitosa*—a form with the corolla-tube much exceeding the calyx.

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* *P. angustifolia* occurs near the top of the range, not far from the lakes, but on the Saguache County side.

† It may here be worth while to record that Mr. W. C. Roby sent me a specimen of what is apparently without doubt *P. viscosum*, Nutt., collected at 12,000 feet on Holy Cross Mountain. This adds a new locality for this rare species.

HYDROPHYLLACEÆ. *Phacelia sericea*, near the lakes, and *Hydrophyllum occidentale* var. *Fendleri*, near the Micawber Mine.

BORRAGINACEÆ. *Mertensia Sibirica* and *Omphalodes nana* var. *arctioides*, both near the lakes and near Brush Creek—the last of course, at timber line, its brilliant blue flowers almost dazzling. *Mertensia lanceolata* occurs above timber line, near Brush Creek, and near the Micawber we get *Echinospermum floribundum*.

SCROPHULARIACEÆ. *Pedicularis Grœnlandica*, at the lakes; *Pentstemon glaucus* var. *stenosepalus*, both at the lakes and at timber line, above Brush Creek. *Mimulus luteus* and *Pedicularis procera* occur near the Micawber. The various forms of *Castilleia* have already been discussed in a previous paper. *Veronica alpina* and *Pentstemon cæspitosus* are found in the gulch above the Micawber.

OROBRANCHACEÆ. *Aphyllon fasciculatum*, at the Micawber.

LABIATÆ. Not one observed!

CHENOPODIACEÆ. *Chenopodium album*, introduced accidently at the Micawber, but useful as an excellent substitute for spinach.

POLYGONACEÆ. *Eriogonum flavum* and *Polygonum Bistorta*, above the timber line, near Brush Creek.

ELÆAGNACEÆ. *Shepherdia Canadensis*, near the Micawber.

URTICACEÆ. *Urtica gracilis*, near Brush Creek.

CUPULIFERÆ. *Quercus undulata*, on sunny slopes near the Micawber and in Horseshoe Bend Gulch.

SALICACEÆ. *Salix monticola*, near the Micawber, and plenty of *Populus tremuloides*. Higher up, the quaking-aspen is reduced to a f. *nana*, 6 to 10 feet high, stems branching from the base upwards, with the small leaves, and red petioles.

CONIFERÆ. *Picea Engelmanni*, below the lakes; and *P. pungens*, near the Micawber, as well as *Juniperus communis* var.

alpina. A *Pinus* doubtfully referred to *flexilis* occurs near the Micawber Mine.

LILIACEÆ. *Allium reticulatum* and *Streptopus amplexifolius*, near the lakes, the first being characteristic of high altitudes. *Zygadenus*, near the Micawber, and also *Allium cernuum* f. *obtusum*, with rose-colored flowers, and obtuse perianth-segments.

JUNCACEÆ. *Juncus Mertensianus*, at the lakes, and *Luzula parviflora*, near Brush Creek.

CYPERACEÆ. *Carex Gayana* and *C. atrata* v. *ovata*, near Brush Creek.

GRAMINEÆ. *Bromus ciliatus*, *Agrostis niemalis* and *Elymus Americanus*, near Brush Creek. *Phleum pratense*, is a " casual " near the Micawber.

HEPATICÆ. *Marchantia polymorpha*, at the Micawber.

FUNGI. *Hypocrea Richardsoni*, *Melampsora salicina*, *Phragmidium subcorticium* and *Lycogala epidendrum*, near the Micawber. I observed, and have made descriptions of, seven species of *Agaricus*, one *Coprinus*, and one *Boletus*, but I have not yet been able to identify them.

LICHENES. *Usnea barbata* produces a very striking effect in Swift Creek Gulch and Horseshoe Bend Gulch.

The features of an alpine flora are very striking as compared with those of lower altitudes. Many orders and genera, so abundantly represented further down, are here only conspicuous by their absence. Such plants as the gentians and saxifrages become abundant. The prevalent colors change; blue and pink flowers become commoner, yellows and reds more rare. Nor is this phenomena in any way confined to our present district: Mr. F. W. Anderson, whom I questioned on the matter, wrote me that he had observed the same thing in Montana.* Hereafter, I hope to be able to elucidate this matter more fully. It is of great interest, as here, at any rate, we seem to see the manifest result of environment in inducing changes which finally become sufficiently fixed to produce new species. In my former paper on *Castilleia* I have shown how pink replaces scarlet; in this paper some interesting cases of color-variation are recorded, but many more instances might be given, illustrating the effect of altitude. Dr. Weismann, whose views on the non-inheritance of acquired characters are now exciting so much attention, has considered it not unlikely that changes in organisms produced by climatic influences may be inherited, a reservation which seems to be endorsed by all experience.

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* Mr. Anderson wrote, (December 4th, 1889)—" Yes, blues and pinks do seem to replace yellows and reds in alpine regions, and not necessarily high alpine either; but our difference in latitude may make up for the lack of extremely high altitude. Examples you ask for! Phloxes, Lupins, Asters, Erigerons, Gentians, Astragali, Pentstemons, Delphiniums."

Dr. A. R. Wallace, in "Darwinism," (p. 401), remarks on the apparent scarcity of monocotyledonous plants in the Rocky Mountains. Although published works, and indeed this present list, would seem to confirm this view, I do not think it is actually the case; the grasses, etc., of high altitudes in the West not yet having received the same amount of attention as those of the eastern or northeastern regions. When we know the flora completely, surely the percentage of Rocky Mountain monocotyledonous plants will be increased. Dr. George Vasey seems to be of the same opinion, for he writes me, (March 8th, 1890): "It appears to me that monocotyledonous plants are as numerous proportionately in high altitudes as in lower ones." Dr. Wallace himself, to whom I stated my objection, replies, (February 10th, 1890): "In the Rocky Mountains I think there is a real scarcity of monocotyledons, especially bulbous Liliaceæ, Amaryllids and Orchises. This struck me as being the case."

No doubt, excluding the grasses and carices, this may hold good, at least with regard to the comparison of very high altitudes with rather more moderate ones. But in the Wet Mountain Valley, (about 8,000 feet), there are eight species of orchids.

I made a catalogue of the high altitude plants mentioned in Dr. Britton's lists of Dr. Rusby's South American gathering, and although the result is interesting, it is not suitable for comparison with the present list, as from the plants listed, 10,000 feet near La Paz would seem to correspond climatically with about 7,000 feet, (or perhaps lower), in Colorado.

WEST CLIFF, CUSTER CO., COLORADO.